XI. *Researches into the Structure and Development of a newly discovered Parasitic Animalcule of the Human Skin—the* Entozoon folliculorum. *By* Erasmus Wilson, *Esq., Lecturer on Anatomy and Physiology in the Middlesex Hospital. Communicated by* Robert Bentley Todd, *M.D., F.R.S.*

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In the June Number of Muller's Archiv (for 1842) there appeared a paper from the pen of Dr. Simon of Berlin, announcing the discovery of certain animalcules, which he regarded as Acari, in the sebaceous substance of the follicles of the human skin. After perusing his account of these singular creatures I was induced to engage in the inquiry, and was so much interested in what I saw, that I devoted six months of exclusive labour to the study of their structure and mode of development. The result of my research is at variance with the description of their structure given by Dr. Simon; it corroborates Dr. Simon only in the general fact of the existence of these animals and their diversity of form, while it offers several new and original observations for consideration. Among the latter I may refer especially to the anatomy of the head, which Dr. Simon regards as composed of certain moveable organs, but which in reality is distinct from those organs; the discovery of eyes; of a power of retracting the head within the thorax; of ova; of a remarkable embryonic form; and of the progressive development of the young animal.

The situation of the animalcule in the zoological system is a question still to be determined, and it is one on which I have felt unwilling to speculate until a complete description of the creature shall have been placed before scientific entomologists. The name given to the animal by Dr. Erichson of Berlin and adopted by Dr. Simon, namely *Acarus folliculorum*, is founded on the erroneous view of the anatomy of the head and mouth, put forth by the latter gentleman. The animal is not an *Acarus*, for it has no haustellum; nor is it an *Arachnidan*, for it possesses a distinct head, susceptible of retraction within the thorax, and an abdomen most indubitably annelidous in structure. Under these circumstances I have followed, in the present paper, the suggestion of Dr. Todd, and have made use of the term Entozoon, signifying merely an inhabitant of the interior of the body, as a temporary appellation, until a better and more suitable one shall have been invented.

The *Entozoon folliculorum* is found in the sebaceous substance of the hair-follicles; it feeds upon the secretion contained within the sebaceous cells, and its young are produced from ova in the midst of the sebaceous matter. The presence of these animalcules has no reference to disease of the skin or of the follicles; they are met with

in almost every person, but are most numerous in those in whom the skin is naturally torpid, in invalids, and in the sick. Their numbers are various; in some persons not more than two or three can be found in a follicle, while in others I have seen upwards of fifteen, indeed the follicle has been completely distended by them. Their position within the follicle is peculiar, the head is always directed inwards, while the tail is directed in the opposite sense; and when a number are present, they have the appearance of being collected into a conical bundle, the large end of the cone being formed by the heads. The situation in which these little animals are most commonly found is the integument of the face, and more particularly that of the nose, but I have also met with them in the follicles of the back, and of the breast and abdomen; I have not yet found them on the limbs.

As regards the size and form of the animalcules there is considerable variety, some of the differences being referrible to growth and development, and others amounting to a specific distinction. They pass their whole existence in the sebaceous substance, undergoing ecdysis repeatedly during their development and growth; and are finally expelled from the follicles with the secretion of those organs. For examination, they are obtained by compressing a follicle and placing the small mass which escapes from its aperture in a drop of olive oil between two plates of thin glass. By a slight movement of the glasses the sebaceous matter may be broken up and distributed without injury to the animalcules, but if much pressure be employed, they will be in danger of being crushed. When prepared in this manner, they may be seen to move with activity for many hours, and they are so tenacious of vitality that I have found them alive in a subject in the dissecting room that had been dead for fourteen days. They are seen very distinctly with an object-glass magnifying fifty diameters.

The perfect animal may be known by the following typical characters: it is elongated in figure, being several times longer than the breadth of its body; and is divisible into a head, thorax and abdomen; the head being more distinct from the thorax than the latter from the abdomen.

The head is subconical in form, obtusely truncated anteriorly and depressed. It is connected with the thorax by means of a narrow segment formed by a fold of integument, and can be withdrawn within the thorax so as to be completely buried from sight. When the head is protruded the outline of the narrow segment is distinguished by two slight grooves, which are seen with the microscope as boundary lines; but when the head is retracted the segment is seen as a thick folded border, which constitutes the anterior extremity of the animal.

The truncated extremity of the head is composed of two moveable, arm-like organs, which lie side by side, and together with two intermediate antennæ-like organs, constitute the entire breadth of the snout. The cephalic arm-like organs or palpi are cylindrical at their bases, where they are continuous with the general tegument of the head, and become somewhat smaller and prismoid towards their distal end. In the latter situation they are truncated and present a flattened extremity. They appear

to be formed by a bifurcation of the head and by the prolongation forwards of the divided portions, to an extent which is about equal to one third of the length of the head. In structure, the cephalic palpi are composed of three or four annulate segments connected by capsular membranes, the last segment or carpus having its flat and triangular palm furnished with four or five membranous claw-like phalanges with obtusely pointed extremities. On the outer angle of the penultimate segment is a prominent tubercle, which has the direction of the axis of the arm. The cephalic palpi are furnished in their interior with muscular fibres, which form a thin stratum beneath the integument, and are continuous posteriorly with the general muscular system of the animal. Of this muscular apparatus, the flexor and extensor fibres are most strongly marked.

The motions of the cephalic palpi are extensive and powerful in the direction of flexion and extension, but very limited in the sense of abduction. By virtue of the laxity of the capsular membranes of their annulate segments, they also admit of retraction. The actions of flexion and extension aid the animal in progression, and in consequence of the inward obliquity of their movement, they also serve the office of organs of prehension, by conveying directly to their mouth portions of sebaceous substance, from which the animal may suck the juices.

The upper surface of the head is depressed, sloping gradually downwards and forwards from the occiput to the extremity of the snout, which is either curved suddenly downwards or slightly upwards, according as the animal is seen in the state of flexion or extension of its cephalic palpi. Along the middle of the head in its longitudinal axis is a slight groove caused by the prominence on each side of the cephalic palpi; and lodged in this groove is a flask-shaped flattened organ (labrum?) which forms a part of the base of the head behind, and terminates anteriorly opposite the bifurcation of the cephalic palpi in a linguiform point. The flask-shaped organ is slightly curved in its form; its upper surface being smooth and convex, the under concave. From the concave under surface there appear to proceed four pairs of jointed tentacula, which in the first instance pass forwards, and becoming perceptible beyond the end of the flask-shaped organ, give rise to the appearance of a succession of progressively diminishing rounded segments, and then bend downwards to either side of the mouth of the animal. Proceeding also from this organ as far back as the base of the neck of the flask are two larger, antennæ-like tentacula, which seem to arise from its under part at each side and run forwards parallel with the neck of the flask and its segmented prolongation. Immediately in front of the latter, the larger pair of tentacula approximate and pass onwards parallel with each other to near the extremity of the snout, where they curve downwards and backwards to the front of the mouth. These tentacula are slightly constricted from point to point, the constrictions probably performing the office of joints, and at their termination are slightly curved outwards. They are capable of a moderate degree of movement in the direction of flexion and extension.

The flask-shaped flattened organ terminates posteriorly in a narrow elongated process which is received between two oval, flattened organs within the head, and these latter are connected with two large reniform organs which constitute the bulk of the head. Moreover, it is to these oval-shaped organs that the muscular apparatus intended to retract the head is attached. The oval-shaped organs are marked in the middle by a small indistinct circle, and on each side by a dark spot, produced apparently by a deposit of pigmentary matter.

On the under surface of the head in the middle line, and occupying the anterior half of its length, is an oblong opening, the mouth; it is surrounded in front and on the sides by a broad and raised border, consisting of a number of tentacula, four pairs of which may be distinguished as being superior and three inferior. There are consequently no less than sixteen tentacula surrounding the aperture of the mouth; the central pair, or antennæ-like tentacula, proceed, as I have before remarked, by the side of the neck of the flask-shaped organ, while the four remaining pairs appear to originate from the under surface of that organ. The three pairs of inferior tentacula are productions of the integument from the posterior boundary of the mouth, the external pair being the longest, and the innermost pair merely rudimentary. Behind the mouth the boundaries of the pharynx are seen through the transparent integument.

The tentacula are capable both of lateral and central approximation, and by these movements effect a closure of the aperture of the mouth. They cooperate in the act of prehension and detention of food, and by their close contact constitute a temporary haustellum by which the fluids of the nutritive mass are expressed and imbibed by the animal.

Immediately within the tentacula are situated a considerable number, probably from four to ten pairs, of maxillæ which form an internal border to the mouth. The maxillæ are elongated cylindriform organs, projecting by their free extremity one beyond the other along the border of the mouth, from its posterior to its anterior boundary, and corresponding by their axes with that of the head. They are apparently attached to the pair of large reniform bodies which form the principal bulk of the head, and by their shafts constitute the walls of the pharynx.

The maxillæ, like the tentacula, are capable of close approximation, both in the lateral and central direction, and are consequently well adapted to assist the latter in the office of suction, and at the same time to masticate substances presented to them by the tentacula. In the latter action the tentacula would hold the nutritive substance, while the maxillæ are engaged in its trituration and deglutition.

Within the head, and constituting the bulk of this part of the animal, are two oval-shaped or reniform bodies of an opake white colour. These bodies are slightly flattened from above downwards in conformity with the shape of the head; they are broad in front, somewhat narrower behind, where they are separated by a narrow interspace, convex on their outer border, and flattened on the middle line. In the

latter situation they are excavated in front to form the pharynx, and behind the mouth appear to be continuous for a short extent by means of an isthmus of communication. When these bodies are examined on the upper surface, a dark globular body will be seen to be imbedded in the substance of each near its anterior extremity. This globular body is an eye of the simple kind, and is surrounded by a circular line representing an orbit. On the middle line the mode of junction of the reniform bodies is concealed by the flask-shaped organ, and posteriorly it is to these bodies that the oval-shaped pieces of the flask-shaped organ are attached.

These reniform bodies constitute, as I have before remarked, the essential part of the bulk of the head; they give support to the eyeballs; they form the pharynx; they afford a point of connection to the maxillæ, and by means of the flask-shaped cephalic organ, they give attachment also to the superior tentacula. When retracted into the cavity of the thorax, these bodies may be very distinctly seen through its thin and transparent integument. Besides the movement of retraction within the thorax, the head admits of flexion and extension, and of a lateral flexion produced by rotation on its own axis. The thorax is the largest and broadest part of the animal; it is flattened upon its ventral surface, convex on its dorsal and lateral surfaces, narrower in front than behind, and somewhat larger toward the middle than at either extremity. It is composed of four broad and continuous annular segments, which are distinguished on the ventral surface of the thorax or breast by four strongly-marked transverse lines, and on the dorsal surface by as many broad and shallow transverse grooves. These shallow grooves are produced by a convexity of each of the segments from before backwards; they correspond inferiorly with the spaces between the legs, while the convex portion of each segment is on a line with the attachment of the legs. With the ventral surface of each of these segments on each side of the breast, the four pairs of legs of the animal are articulated.

The ventral surface of the thorax is flattened, and the epidermic covering is thicker in this situation than on the rest of the body. Running along the middle line of the breast, the whole extent of the thorax, is a double line (sternum) formed by two ridges which are broken at short distances and are continuous with the four transverse thoracic lines. The latter also consist of double ridges and run outwards, forming the boundary mark between the thoracic segments. The most anterior of the transverse ridges commence at the extremity of the median ridge, and pass obliquely forwards and outwards at each side to the space between the base of the anterior leg and the collar of the neck, forming the anterior boundary of the thorax on its ventral aspect. These ridges are slightly curved in their course, the convexity being directed forwards, and taken together, give the idea of a bifurcation of the median ridge anteriorly. The second pair of ridges pass nearly horizontally outwards to the groove between the first and second pair of legs making a very gentle curve, the convexity of which is directed backwards. The third pair of ridges are more horizontal in their direction than the preceding, and run to the groove between

the second and third pair of legs, also forming a gentle curve, whose convexity is backwards. The fourth pair of ridges proceed obliquely outwards and backwards on each side, and terminate at the groove between the third and fourth pair of legs. There is no line of separation between the thorax and abdomen, and the median ridges gradually diminish in their prominence on the last thoracic segment, until at the boundary of the latter they are lost. The spaces of the breast included between the transverse ridges in front and behind, and the median ridge and base of the legs laterally, are irregularly quadrangular in form, and increase in breadth from before backwards in consequence of the greater separation between the legs.

The lateral and dorsal portion of the thoracic segments is marked on its surface by a number of transverse lines situated at minute but regular distances. The spaces between these lines represent so many narrow plates which are unbroken from the base of the lateral portion of each thoracic segment across to a similar point on the opposite side, and overlap each other slightly from before backwards. On the convexities of the thoracic segments on each side, near their bases, the plates converge and become more imbricated than in their upper portion. By this arrangement a small triangular interval is left in the concavities of the segments which is occupied by short supplementary plates.

The thorax admits of flexion to a limited extent, both in the antero-posterior and in the lateral direction, and of a slight degree of retraction in the longitudinal axis.

The legs are four in number on each side; in general form they are conical, broad at their bases, where they are attached to the side of the under part of the thorax, and truncated at their free extremities. They are composed of three segments; the proximal segment covers by its articulation a considerable expanse of surface, extending for some distance inwards upon the breast, and outwards upon the side of the thorax. In longitudinal extent it occupies very nearly the entire breadth of the thoracic plate. This segment resembles in its form the base of a cone obliquely truncated from before backwards; its anterior depth being considerable and the posterior very narrow. On the outer side of this segment, and along its base and inferior border, are situated several spinous tubercles, and at the extremity of the anterior margin is one of larger size than the rest; it is curved backwards. The proximal segment is articulated with the thorax by means of a loose capsular membrane, which permits of a trifling degree of retraction of the segment within the cavity of the thorax, and also allows of a slight degree of motion in all directions; the principal movement of the segment being forwards and backwards. The middle segment is a cylindrical piece articulated with the preceding by means of an exceedingly loose capsular membrane. Its movements are flexion and extension in the antero-posterior direction, and retraction to a considerable degree. The antero-posterior movements are very extensive; the former almost buries the middle in the superior segment, approximates the third piece and recurved tubercle of the anterior border of the proximal segment, and performs a sharp, angular flexion posteriorly;

while the latter directs the middle piece nearly horizontally backwards, and converts the posterior projecting angle into a receding angle. The capsular membrane of this articulation during the movements of the segment, is raised into a fold on the side corresponding with extension, and reminds one very forcibly of the analogous manner of articulation of the crural segments in the Lobster. The third segment is short, and admits at a very trifling extent of movement on the extremity of the middle piece. It is flat on its distal surface, and provided with seven or eight digital processes or phalanges, which during the movements of the limb, are one while drawn together and straightened so as to have the appearance of a single conical point, and another while separated and curved, so as to resemble a number of hook-shaped claws. The latter is their more frequent condition.

The contents of the thorax are very indistinct, on account of the general transparency of the animal, and I have been quite unable to detect anything like a proper organ. On two occasions I saw some granules rising and falling in a central direction, being bounded on each side by a faint longitudinal line; this I conceived to be some alimentary substance moving in the œsophagus. The difficulty of perceiving any organ within the thorax is moreover increased by the presence of numerous adipose vesicles which constitute the subtegumentary tissue. On bringing the interior of the thorax to a focus, some faint waving lines may be seen along the sides of that cavity; these are the muscles of the legs, and they are continuous with the retractor muscles of the head; the latter appear to be attached to two ridges which project from the upper and lateral part of the two first thoracic segments. In the upper and anterior part of the thorax I have observed pretty constantly a transparent spot that seems to be an unoccupied space, bounded by the substance of the animal below and by the vaulted transparent integument above. This space has reference to the retraction of the head within the thorax.

The abdomen is the largest of the three divisions of the body, usually several times longer than the thorax, but somewhat smaller in diameter at its commencement than the latter, and tapering more or less to its termination. Its form is that of a cylinder slightly compressed from above downwards, being flatter on its under than its upper surface. The integument of the abdomen is composed of narrow annular segments which overlap each other from before backwards, and become narrower towards its extremity. These segments have a beautiful appearance when seen with the microscope, and give the idea of an exceedingly delicate coat of plait armour. When examined along the edge of the abdomen they exhibit a serrated outline, the serrations being sharp and accurately defined. Upon the under surface of the abdomen, close to its extremity, is a small opening which sometimes appears circular and sometimes elliptical in shape, the long diameter of the ellipsis being directed transversely; this is the anus.

The segmented structure of the abdomen permits of flexion of this part of the animal in every direction, namely, forwards, backwards, and laterally. Indeed, when

the abdomen is long, it is frequently seen to present a succession of curves and to assume an undulated position. Besides flexion, the abdomen is capable of contraction both in the longitudinal and horizontal direction. I have sometimes seen one or two horizontal contractions which have straitened the diameter of the cylinder very considerably, and have given it the appearance of being tightly constricted by a string.

The structure of the interior of the abdomen, like that of the thorax, is difficult to determine, on account of the extreme transparency of the animal and great number of adipose vesicles which, in clusters of various sizes, form the subcutaneous stratum. Externally to this stratum is a thin membrane which lines the epidermic case, and which, under compression, I have sometimes seen separated to a greater or less extent from the latter. The more general appearances of the abdominal contents are,—a large, rounded or oblong mass of a light brown colour, situated close to the thoracic extremity; another light brown mass at about one third from the extremity of the tail; an irregular cellular mass between the two former, and a transparent portion at the caudal end. The most anterior of these masses is composed of nucleated granules; in one instance it presented a distinct pouch-like figure with well-defined boundaries, but more usually it is irregular in form, sometimes extending for a short distance into the thorax, and at other times being prolonged by a pointed process backwards. Whatever its form, it is traversed through the middle by a curved, cylindrical canal, which appears to represent the stomach, the dark granules being very probably hepatic corpuscles. The cellular mass which succeeds the gastric organ consists of an assemblage of transparent vesicles of various magnitude, some large and some small. In the midst of these the alimentary canal may generally be traced as a slightly shaded band, somewhat curved in its course. The third mass, namely, that which occupies the commencement of the posterior third of the abdomen, is composed, like the first, of nucleated granules or cells: this mass is smaller than the first; I have been unable to trace the alimentary canal through it, and I am inclined to regard the granules as constituting the ovarium. The remaining part of the abdomen I have described as being transparent and empty of granules; this, however, is not constantly the case, for the granules sometimes extend to the very extremity of the abdomen. In a few instances I thought that I could perceive the latter part of the alimentary canal passing through this part of the animal and terminating by a dilated cloaca at the anal aperture.

In the course of my observations on the *Entozoon folliculorum*, I have distinguished two principal varieties of the adult animal which are marked by strongly characteristic, if not by specific features. The first of these is of large size, fine proportions, and is remarkable for the great length of its abdomen and the roundness of its caudal extremity. The second is characterized by a certain degree of clumsiness of form, shortness of abdomen, and pointedness of the caudal extremity.

The *long* form varies in size from the $\frac{1}{100}$ to the $\frac{1}{45}$ of an inch in length; the latter measurement, that is, somewhat more than a quarter of a line, being that of the

longest specimen I have seen. The body of this animal, from the snout to the base of its posterior legs, measured $\frac{1}{250}$, and the greatest breadth of the thorax $\frac{1}{500}$ of an inch. Of the smallest there were two specimens, of which the same measurements were—

Entire length.	Length of body.	Greatest breadth.
$\frac{1}{100}$	$\frac{1}{280}$	$\frac{1}{480}$
$\frac{1}{100}$	$\frac{1}{312}$	$\frac{1}{555}$

Of fifty specimens, the largest number measured in extreme length from $\frac{1}{70}$ to $\frac{1}{60}$ of an inch. In length of body the greatest number measured (in round numbers) $\frac{1}{275}$, in length of head $\frac{1}{1000}$, and in greatest breadth $\frac{1}{500}$ of an inch.

The *short* form varies in extreme length from $\frac{1}{160}$ to $\frac{1}{109}$ of an inch. The shortest specimen that I have met with measured in length, namely, from the snout to the base of the posterior legs, $\frac{1}{330}$, and in greatest breadth, $\frac{1}{550}$. The longest, namely, that which measured in extreme length $\frac{1}{109}$, measured in length of body $\frac{1}{345}$, and in greatest breadth $\frac{1}{530}$ of an inch.

Turning my attention to the development and mode of growth of the Entozoon, I met with some curious results,—results that led me to the conclusion that the two varieties are developed in a manner peculiar to each; that both proceed from ova, but that the larger kind pass through an intermediate developmental form in which the shorter do not participate. Probably this peculiarity may depend on some unknown modification of the elements of nutrition, and, very possibly, on the same cause with that which determines the greater length of the animalcule. In reflecting on this peculiarity I was reminded of the modification which the young of the common earth-worm presents in a soil of variable tenacity, in the one case being extruded from the oviduct of the parent surrounded by a nidamental covering, and in the other in its perfect state. Here is an important modification having reference to the security of the young; the peculiarities in development of this Entozoon may have an analogous purpose.

The ova of the *Entozoon folliculorum* are bodies of considerable size, and, as I failed in discovering any body of similar proportions within the abdomina of the many hundred animals which I have examined, I came to the conclusion that in their earlier state they were the nucleated cells which so commonly formed a cluster within the caudal extremity of the abdomen, and that these cells underwent development out of the body of the animal. I was strengthened in this view by occasionally finding small masses of these cells in the neighbourhood of the Entozoon. These masses were of an amber colour, and composed of nucleated cells, each of which measured about $\frac{1}{2500}$ of an inch in the long and about one-fourth less in the short diameter. In the vicinity of the masses of small cells I frequently saw cells of somewhat larger size (Plate XVI. fig. 12.) composed of secondary cells, and others, of a more or less oval shape, containing within their investing membrane secondary nucleated cells of various size and in considerable number (Plate XVII. fig. 13.). The measurement of

the latter bodies (transition ova) varied between $\frac{1}{1667}$ and $\frac{1}{1000}$ of an inch in the short diameter, and $\frac{1}{1250}$ and $\frac{1}{769}$ in the long axis. The perfect ova are oval in shape, somewhat larger at one end than at the other, about twice the length of their breadth, semitransparent, amber coloured, and composed of nucleated granules or cells inclosed in a thin and yielding membrane. They vary in length from $\frac{1}{500}$ to $\frac{1}{320}$, and in breadth from $\frac{1}{833}$ to $\frac{1}{555}$ of an inch.

The first developmental change observable in the ovum is the disintegration of the tesselated plane of nucleated cells which constitute the surface of the ovum, and lie in contact with its investing membrane. These cells, which are at first polygonal in form, become rounded and larger in size, and the cells of the centre of the ovum acquire a considerable preponderance in bulk over those of the periphery. Subsequently to these changes the cells assume a special arrangement, they become aggregated into a small oblong mass, which is curved at each end, and is not unlike the embryo of higher animals, while a space is formed between the trunk of the little mass and the membrane of the egg. The next stage would seem to be the rupture of the egg-membrane and the expulsion of the embryo, but this process I have not observed in operation, although I have seen on the one hand embryos which appeared to be just released from their investing membrane, while on the other I have detected egg-membranes evidently cast off by ecdysis. In some few of the ova I have observed adipose cells, some large and some small, mingled with the germinal cells.

It is a curious fact, that in the development of the *Entozoon folliculorum*, a remarkable embryonic form is met with which is peculiar to the long variety of the animal, and is not met with in the shorter kind. This embryonic body is elongated, rounded and bulky at one extremity; smaller, somewhat tapering and blunt-pointed at the other, and enlarged towards the middle by the development from one of its sides of two oval-shaped prominences which subside gradually into the larger end and join the smaller end, either at a right or at a receding angle. This peculiarity of form enables us to divide the embryo into a body, which comprises the larger end and these two oval prominences, and a tail, which is the smaller and shorter end; the principal changes in its form taking place, in the course of development, being the elongation of the tail and the enlargement or subsidence of the oval prominences. The dimensions of the embryo are $\frac{1}{312}$ to $\frac{1}{217}$ of an inch in the long, and $\frac{1}{714}$ to $\frac{1}{555}$ in the short diameter. In structure the embryo presents a close analogy with the ovum, being composed of nucleated cells, having the same disposition and appearance, and enclosing in the centre of their mass a number of larger cells. The larger cells correspond in position with the broadest part of the embryo, and extend more or less in proportion to its development into the cephalic and caudal portions. They also vary in their size, the central cells being the largest, while those which surround them are small and more numerous.

The smallest of the ova that I have examined are something less in length than

twice their breadth, but, as they progressively enlarge, they undergo a corresponding alteration in their form; they become elongated, they swell towards the centre, and one end acquires a slight predominance in bulk over the other. This change in the form of the ovum converts it into an embryo; in one position the embryo is still oval, the one extremity being somewhat larger than the other, but as soon as it rolls over on its side the prominence of the middle part is perceptible. At this period the tail is shorter than the bulky part, and the latter scarcely presents any trace of division into the two lobe-like protrusions that are subsequently formed. As the embryo progresses in size the lobes become more apparent, and, seen from the front, the entire body is not unlike an ace of clubs with an elongated stalk. The next advance in growth is indicated by a further increase in length of the tail portion, and a more equable enlargement of the rest, so that the subdivision of the convex mass, although still apparent, is less manifest than it had been previously.

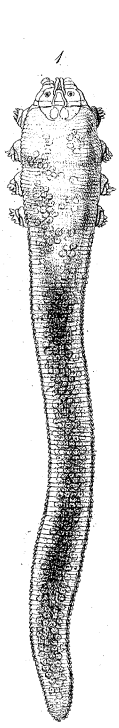
The form of embryo just described was that of the specimen which measured $\frac{1}{217}$ of an inch in length. Lying near to this in the same mass of sebaceous substance was another, a very little longer, being only $\frac{1}{200}$ of an inch in length, but different in proportions. It was divisible into a head, a thorax, and a tail-like abdomen. The head was a rounded portion of the mass, distinguished from the rest by a slight constriction, but presenting no distinction of parts. The thorax was oval in shape, largest in the middle, and diminishing towards the ends; and the abdomen was cylindrical, much less in diameter than the thorax, and uniform in size. The animal appeared to be composed internally of an assemblage of cells enclosed in a thin membrane. The cells were all of the same size, or differed but little in this respect, and there was no trace of markings upon any part of the tegumentary covering. There was one character however in this specimen which distinguishes it at once from the embryonic form, and which has induced me to regard it as the first stage of development of the young animal. This character is the presence of three pairs of legs, which are extremely short, and look like conical prolongations of the substance of the animal. In a more advanced stage the divisions of the body become more distinctly defined, and begin to assume the characters by which they are approximated to the perfect animal. The head, for instance, is seen to be composed of two oval-shaped lobes, and a conical central piece, projected at the extremity of the body; the thorax still retains its oval form, but is broader behind than in front, and the abdomen tapers gradually backwards to a rounded point. Other indications of the immature state in more advanced stages are,—the absence of cephalic palpi; the shortness and straitness of the thorax; the absence or small size of the phalanges; the great length of the cylindriform and tapering abdomen; the slightness of the thoracic and abdominal markings; and the confused and cellular structure of the interior. I have found the length of the young animal while possessing only three pairs of legs, to range between $\frac{1}{200}$ and $\frac{1}{59}$ of an inch, while in breadth its measurements were from $\frac{1}{833}$ to $\frac{1}{500}$. After the attainment of four pairs of legs, its length ranged between

$\frac{1}{75}$ and $\frac{1}{50}$ of an inch, and its breadth between $\frac{1}{625}$ and $\frac{1}{555}$; one remarkably long specimen measured $\frac{1}{46}$.

The development of the short variety of the Entozoon is unattended by an intermediate embryonic form. The elements of the head and the feet are produced from the ovum itself, and with very little alteration in the form of the latter. I have already remarked that the largest of the ova become elongated, and if we suppose that the head is produced from one extremity, while three pairs of legs are projected at the sides, we shall have the young form of the animal. The smallest specimen which I have examined was somewhat exceeded in length by the largest of the ova, measuring only $\frac{1}{333}$, while the ovum measured $\frac{1}{320}$ of an inch. And I found a gradual progression in length from that specimen upwards to the more perfect kinds. This early form, like the analogous one of the long variety, possesses only three pairs of legs, which resemble mere protrusions of the external membrane. The head is equally imperfect in form, and the abdominal striæ are not apparent; the internal structure again is a mere assemblage of cells; the changes which ensue during the progressive improvement of this form are,—an elongation of the abdomen, the formation of abdominal rings, and of the thoracic markings. There is one peculiarity which is more remarkable in the young of the short variety than in that of the larger kind, and that is, the very frequent ecdysis. The three-legged form of the short variety measures in long diameter from $\frac{1}{333}$ to $\frac{1}{167}$, and in breadth from $\frac{1}{1111}$ to $\frac{1}{555}$ of an inch.

Like the long variety, the young of the shorter kind has a four-legged as well as a three-legged stadium, the production of an additional pair of legs becoming apparent after the throwing off one of the exuviæ. During this stage the animal begins to assume the general form of the perfect state; the thorax loses its straitened character and becomes rounded and larger; the abdomen becomes longer, and instead of tapering gradually towards the tail, maintains its bulk until near the extremity, when it becomes suddenly smaller, and forms an elongated point. Moreover, during this period the head is more fully formed; the segments of the thorax and legs are more completely developed, and the abdominal rings more distinct. The internal structure is also modified and improved. The measurements of the four-legged stage of the young of the short variety range in length between $\frac{1}{200}$ and $\frac{1}{135}$, and in breadth between $\frac{1}{625}$ and $\frac{1}{555}$ of an inch.

On reviewing the structure of this remarkable animal, I feel again disposed to revert to the position which it should occupy in the animal kingdom; that it is not a member of the class *Insecta* seems proved by its possession of four pairs of legs; that it is not an *Acarus* must be manifest from the preceding description; and that it is not an *Arachnidan* appears to be equally certain. The distinct separation between the head and thorax, the incomplete separation of the latter from the abdomen, the annulate structure of the abdomen, the free movements of the latter, and especially its capability of contraction, both in the longitudinal and transverse direction, are



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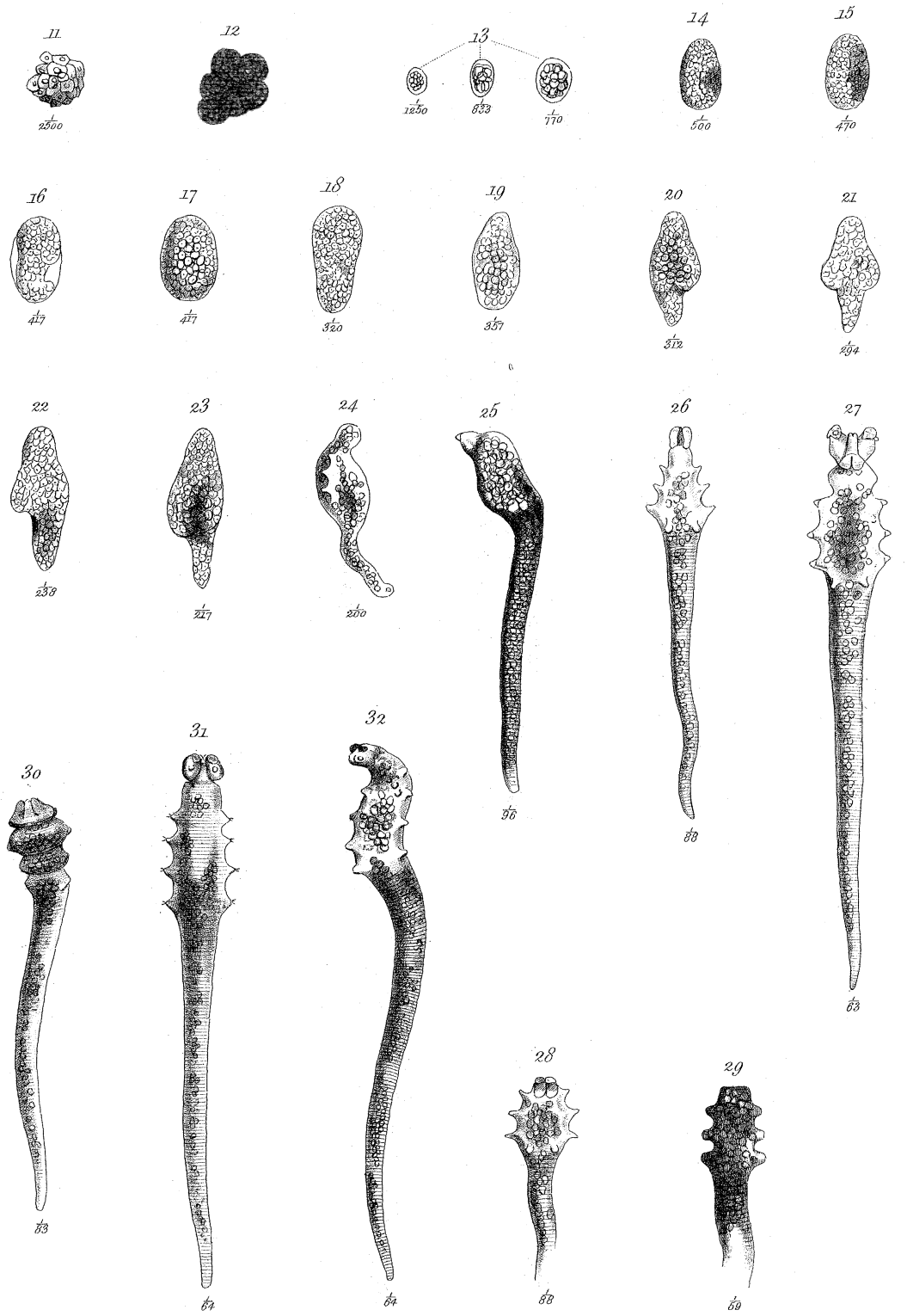

Erasmus Wilson del.[t]

J. Basire sc.

Erasmus Wilson. del.[t]

J. Basire. sc.

arguments for regarding it as an *Annelidan*. While, on the other hand, Mr. GRAY of the British Museum, to whom I submitted the animal, considers it to be allied to the *Entomostracous Crustacea*, to that group of animals intermediate between worms and insects, of which DE BLAINVILLE speaks in the following terms:—"Genre d'animaux tellement bizarres au premier aspect, que les zoologistes sont encore fort peu d'accord sur la place qu'ils doivent assigner à ce groupe dans la série animale"*.

Note.—The foregoing paper was first communicated to the Royal Society in December 1842 and was read in March 1843; previously to being again communicated it was remodelled, the facts remaining the same.—E. W.

EXPLANATION OF THE PLATES.

PLATE XV.

The whole of the figures, with a few exceptions stated in the references, are drawn to a scale of one line to the $\frac{1}{2500}$ of an inch.

Fig. 1. A dorsal view of the long variety; showing tegumentary and internal texture. This animal measured $\frac{1}{63}$ of an inch in length.

Fig. 2. A side view of the same.

Fig. 3. A ventral view of the same animal; the mouth is well shown.

Fig. 4. The short variety; a dorsal view, the head retracted, and seen through the transparent integument of the thorax. The specimen measured $\frac{1}{120}$ of an inch in length.

Fig. 5. The same animal; seen upon its ventral surface.

It will be remarked that these figures are not extremes of measurement; but the difference between them is nevertheless very striking. In addition to relative length of abdomen, the caudal extremity forms a conspicuous character.

Fig. 6. A group of animals found in the sebaceous substance of a living person. This and the two following figures are not drawn to a scale.

Fig. 7. A similar group, situated within a hair-follicle.

Fig. 8. This figure represents a hair-follicle, with two sebaceous glands opening into it. An *Entozoon folliculorum* is seen between the cylinder of the hair and the follicle. It must be remembered that the hair is one of the minute downy hairs of the skin.

Fig. 9. The head, viewed upon its under surface.

a. One of the cephalic palpi, curved downwards; its prismoid truncated extremity is seen, as also the phalanges.

b. A spine or tubercle on its penultimate segment.

c. The reniform body. *d.* The antennæ-like palpi.

e. The four labral palpi.

* Dictionnaire des Sciences Naturelles. Article *Lernée*.

f. The three labial palpi. The row of organs within the palpi are the maxillæ which border the mouth and pharynx.

g. Parts entering into the structure of the pharynx.

h. The boundary lines of the collar.

i, *i*. The first pair of thoracic plates.

k, *k*. The first segments of the anterior pair of legs.

Fig. 10. The head, viewed upon its superior surface.

The letters of reference to *k* are the same as in the preceding figure.

l. The flask-shaped cephalic organ; at the apex of this organ the convexities of the labeal palpi are seen.

m. The eyeball, surrounded by its orbit. *n*. The thoracic carapax.

o. The pointed termination of the flask-shaped organ.

p, *p*. The oval bodies between which it is received, and to which part of the retractor muscle of the head is attached.

PLATE XVI.

Fig. 11. A small mass of ovum-corpuscles ? These corpuscles measured $\frac{1}{2500}$ of an inch; they are not drawn to a scale.

Fig. 12. Ovum-corpuscles increased in growth and containing numerous cells. This figure, like the preceding, is not drawn to a scale.

Fig. 13. Three ova, showing progressive growth. The measurements of these ova were $\frac{1}{1250}$, $\frac{1}{833}$ and $\frac{1}{770}$ of an inch.

Fig. 14. An ovum measuring $\frac{1}{500}$ of an inch in length.

Fig. 15. An ovum measuring $\frac{1}{470}$ of an inch.

Figs. 16, 17. Ova measuring $\frac{1}{417}$ of an inch in length.

Fig. 18. An ovum elongated in figure, and measuring $\frac{1}{320}$ of an inch.

Fig. 19. An ovum which has assumed the form of the next stage of development of the Entozoon.

The whole of the ova here represented exhibit structural modifications, having reference to development. This is particularly evident in figs. 16 and 17.

Fig. 20. Embryonic form of the long variety of the Entozoon; fig. 19 exhibits a transition to this form. The figure measured $\frac{1}{312}$ of an inch in length.

Fig. 21. An embryonic form, in a different position to the preceding. The specimen measured $\frac{1}{294}$ of an inch in length.

Fig. 22. An embryonic form in a different view. Length $\frac{1}{238}$ of an inch.

Fig. 23. The largest embryo I have observed. It measured $\frac{1}{217}$ in length.

Fig. 24. An embryo upon the sides of which three pairs of legs are in progress of development. This is the first gradation in the six-legged stage of the long variety. The specimen measured $\frac{1}{200}$ of an inch in length.

Fig. 25. An animal more advanced in growth, and enclosed in exuviæ. This speci-

men is remarkable for the abundance of cells contained in its interior; it measured $\frac{1}{96}$ of an inch in length.

Fig. 26. A more advanced stage of growth, rudiments of a fourth pair of legs being perceptible. The animal measured $\frac{1}{88}$ of an inch in length.

Fig. 27. The most advanced gradation of the six-legged young. The head is yet very imperfect, as are the fourth pair of legs. This specimen measured $\frac{1}{63}$ of an inch in length.

Figs. 28, 29. Forms which the young animal assumes when it contracts its thorax and withdraws its head. Fig. 28 is the animal represented in figure 26.

Fig. 30. A young animal with four pairs of legs casting its exuviæ. This specimen measured $\frac{1}{83}$ of an inch in length.

Fig. 31. The ordinary form of the four-legged young of the long variety. The specimen measured $\frac{1}{64}$ of an inch in length.

Fig. 32. The same animal turned a little to one side.

PLATE XVII.

Fig. 33. An animal approaching maturity. Its perfection is indicated by the figure and segmented structure of the thorax. It still, however, retains the long, taper and cylindrical abdomen of the imperfect forms. This specimen measured $\frac{1}{50}$ of an inch in length.

Fig. 34. A mature form, somewhat contracted in length and unusually full of nucleated granules. The specimen measured $\frac{1}{86}$ of an inch in length.

a. The anal aperture.

Fig. 35. The smallest young animal of the short variety I have yet examined; it resembled an ovum from which legs were in progress of development. It measured only $\frac{1}{133}$ of an inch in length.

Fig. 36. More advanced form; the lines indicating abdominal segments were apparent on this specimen. It measured in length $\frac{1}{250}$ of an inch.

Fig. 37. An animal undergoing the exuviating change. Its cellular structure is shown. It measured $\frac{1}{255}$ of an inch in length.

Fig. 38. A more advanced stage; the absence of phalanges in all the figures is a prominent feature. They are all cellular in structure. This specimen measured $\frac{1}{167}$ of an inch in length.

Fig. 39. The young state of the perfect animal of the short variety. This specimen is enclosed in its exuviæ; it measured $\frac{1}{140}$ of an inch in length.

Fig. 40. The young state of the perfect animal; the abdomen is perfect, but the legs are rounded and without phalanges. This specimen measured $\frac{1}{116}$ of an inch in length.

Fig. 41. A portrait of the texture of a young specimen of the present form. It is not drawn to the scale.

Fig. 42. A perfect form of the short variety. The animal is turned a little upon its side; it measured $\frac{1}{110}$ of an inch in length.